Naval Mobile Unit
Test Equipment Maintenance Department
Location:-
ID 0407
D1

Farnell

Dual input G. range

power supplies

INSTRUCTION BOOK

INSTRUCTION BOOK FOR

Dual input G. range

power supplies

FARNELL INSTRUMENTS LIMITED , WETHERBY, WEST YORKSHIRE LS22 4DH TEL. 0937 61961

Issue No 1 7-78

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SCHEDULE OF EQUIPMENT

The unit has been carefully packed to prevent damage in transit. When removing the unit from the box ensure that all parts and accessories are removed from the packing material.

The complete equipment comprises :—

a) 1 off G range power supply of the type specified on order

b) 1 off instruction book

c) 1 off packet of accessories comprising:—
   1 off spare fuse
   2 off output terminal nuts
   4 off washers flat
   4 off washers spring
   9 off terminal tags
   4 off fixing screws 8mm long (see note in paragraph 'Mounting and ventilation' on page 8)

Note:— In the event of damage in transit or shortage in delivery, separate notices in writing should be given to both the carriers and Farnell Instruments Ltd., within three days of receipt of the goods, followed by a complete claim within five days. All goods which are the subject of any claim for damage in transit or shortage in delivery should be preserved intact as delivered, for a period of seven days after making the claim, pending inspection or instructions from Farnell Instruments Ltd., or an agent of this Company.

INTRODUCTION

The Farnell G range power supplies use a switched-mode technique to provide stabilised d.c. from a.c. inputs. The techniques employed permit reduced dimensions, weight and internal power dissipation in comparison with conventional series regulator units.

There are two package sizes based on 240 and 360 watts maximum output power. For each package size five nominal output voltages are available (6, 12, 15,24 and 30 volts) with maximum output currents compatible with the particular package power. Each unit may be operated from either 220-240V input or 115-120V input, selected by a front panel link

The output voltage may be set within the range shown in the table below by screwdriver adjustment of the front panel potentiometer. Alternatively the output voltage may be programmed from 1 volt up to the maximum figure shown in the adjustment range. Full output current is available at any voltage setting within this range for ambient temperatures from 0 to 55°C

Provision is made for remote sensing of voltage at the load to correct for voltage drop in the load connecting leads.

The output may be switched on or off by remote control and units may be connected in series or parallel. Presence of output is indicated by a front panel L.E.D.

Current limiting and overvoltage protection are provided and an optional overcurrent trip is available which disables the output after approximately 200mS of current overload.

A 'soft-start' circuit is employed which limits the peak value of input current at switch-on.

Careful consideration has been given in the design of the G range to the problems of radio frequency interference (r.f.i.) and, in this respect, sample units have met the conducted interference requirements of VDE 0875 curve N, CISPR (publication 2) curve N and BS 800.

Models available

Unit type	Nominal output volts d.c.	Output voltage adjust. range d.c.	Output current	Package	Dimensions (mm) excluding terminals Height	Width	Depth	Weight
G6 - 40A	6	4 - 6	40A	240W	88	160	175	3 kg
G6 - 60A	6	4 - 6	60A	360W	88	210	175	3.75 kg
G12 - 20A	12	8 - 12.6	20A	240W	"	"	"	"
G12 - 30A	12	8 - 12.6	30A	360W				
G15 - 16A	15	10 - 15.75	16A	240W	"	"	"	"
G15 - 24A	15	10 - 15.75	24A	360W				
G24 - 10A	24	16 - 25.2	10A	240W	"	"	"	"
G24 - 15A	24	16 - 25.2	15A	360W				
G30 - 8A	30	20 - 31.5	8A	240W	"	"	"	"
G30 - 12A	30	20 - 31.5	12A	360W				

Option C. Units with optional overcurrent trip can be identified by the presence of a suffix 'C' in the model number.

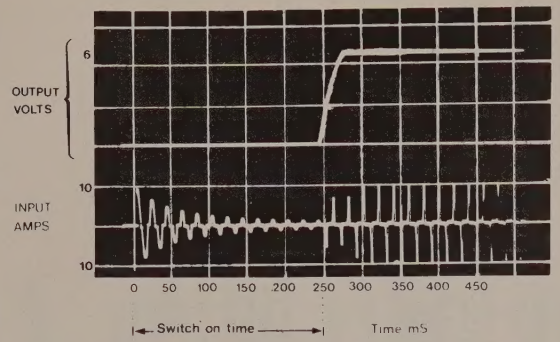
GT6 - 20A	6 and 2 x 15V	4.75 - 6 14.5 - 15.5	20A 1.75A	240W
GT6 - 20AB	6 and 2 x 12V	4.75 - 6 11.5 - 12.5	20A 1.75A	240W

Note: The specification of triple output models is described in a separate leaflet and instruction book

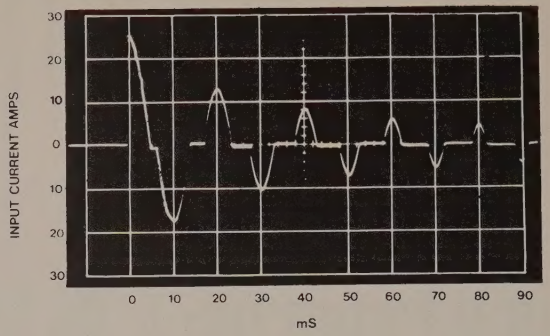
SPECIFICATION

MAINS INPUT	**220-240v or 115-120v with single front panel link 45-440Hz.**
MAINS VARIATION TOLERATED	**220V -20% to 240V +10%** **115V -20% to 120V +10%**
OUTPUT	See 'Models available' on page 2
OUTPUT REGULATION	**0.1% maximum variation for worst case combination of 0-100% load change and 220V-10% to 240V +10% or 115V -10% to 120V +10% line change**
RIPPLE AND NOISE at full load (30MHz bandwidth)	Less than 10mV r.m.s.; 50mV pk–pk
TEMPERATURE COEFFICIENT	±0.01% per ^{o}C typical
OUTPUT IMPEDANCE	100mΩ at 100kHz and 25^{o}C typical
TRANSIENT RECOVERY TIME	Typically 1mS for output to recover within 50mV following a 10–100% or 100–10% load change of 5μS risetime. Typical instantaneous output deviation 350mV
OPERATING AMBIENT TEMPERATURE RANGE	0^{o}C to 55^{o}C for full output current
MAXIMUM OPERATING AMBIENT TEMPERATURE	70^{o}C. Output current derates linearly from full load at 55^{o}C to half load at 70^{o}C
STORAGE TEMPERATURE RANGE	–40^{o}C to +85^{o}C
HOLD-UP TIME	**Output will be maintained for the duration of a missing mains cycle (28mS) at maximum output current and 220V - 10% or 115V - 10% mains input, when the output is at 6V for 6V nominal units and nominal +5% for other units.** *See graph on page 5.*
SWITCH-ON SURGE	Limited by 'soft-start' facility Max. peak current 32A
SWITCH-ON TIME	Output established within 400mS
INSULATION	Tested at 2.1kV peak for 1 minute between a.c. input and d.c. output, with output terminals and earth connected together. ±250V d.c. continuous rating between output and earth. Tested to 500V d.c. for 1 minute.
REMOTE VOLTAGE CONTROL	Programming resistance 1000Ω/V±0.5% Range: 1V to unit max. output voltage
EXTERNAL SENSING LIMITATION	**Up to 5V max. drop in each output lead, also unit output terminal voltage must not exceed 6V for nominal 6V units, or nominal plus 5% for other units, i.e. load voltage + total lead voltage < max. range voltage.**
EFFICIENCY	Better than 70%. Typically 77% at full load
PROTECTION	*Overload* Constant current limiting set at 110%±5% of full load. Option C. As above but after approx. 200mS of overload the output is disabled. *Overvoltage* Set at nominal output voltage +20%. Disables control circuit and output falls to zero *Fuse* The a.c. input circuit is fused
SERIES AND PARALLEL OPERATION	Any number of units with the same output voltage can be connected in parallel. Series operation to a max. total output voltage of 250V
REMOTE ON/OFF	Output is reduced to zero by short-circuiting the 'PROG' and '+S' terminals

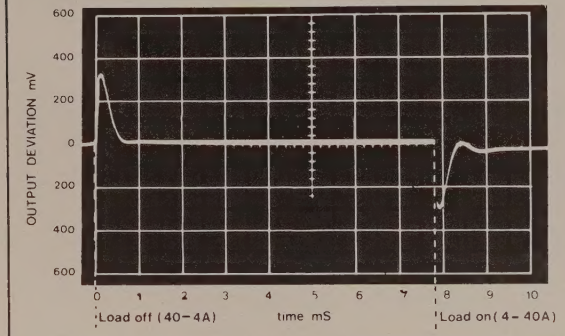
SWITCH-ON TIME G6–40A (TYPICAL)
240V a.c. INPUT



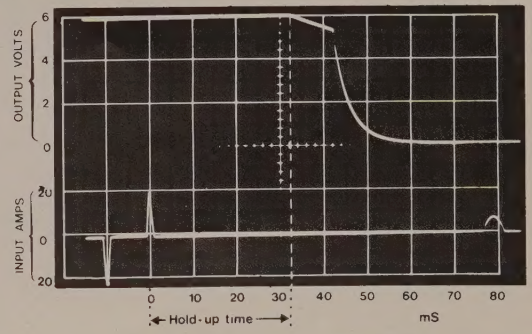
SWITCH-ON SURGE G6–40A (TYPICAL)
264V a.c. INPUT

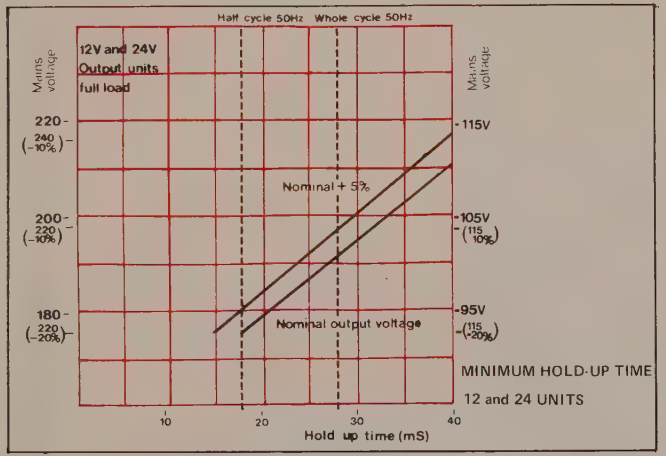


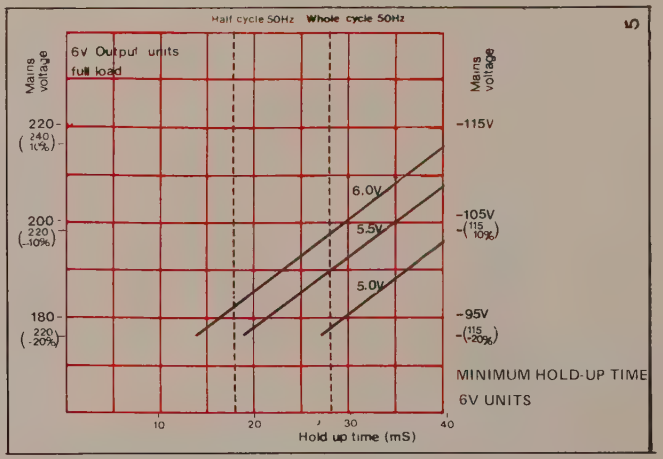
OUTPUT TRANSIENT RESPONSE
5uS RISE TIME G6–40A (TYPICAL)

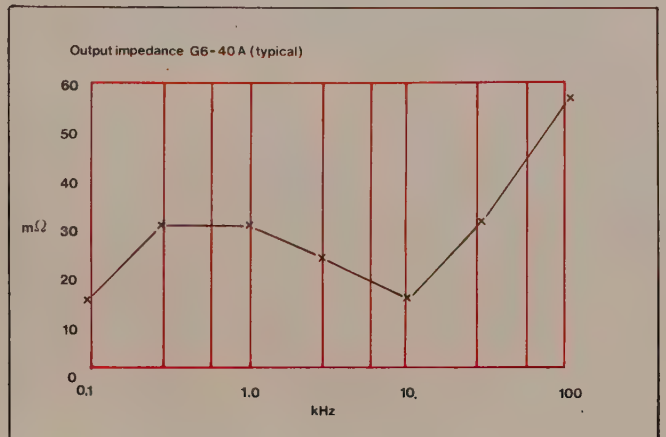


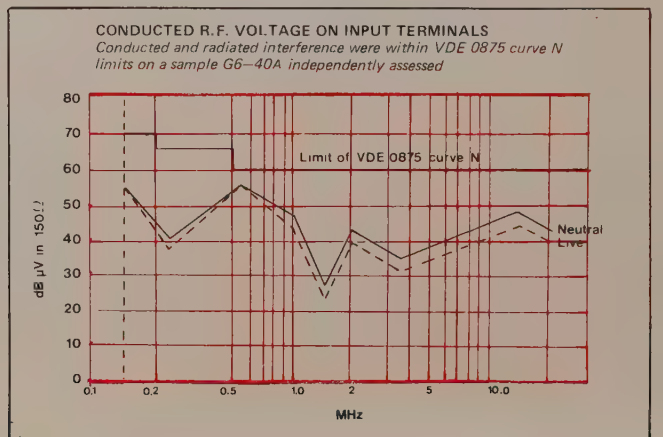
HOLD-UP TIME AFTER INPUT DISCONNECTION
103.5V a.c. INPUT G6–40A (TYPICAL)




Half cycle 50Hz
Whole cycle 50Hz
12V and 24V
Output units
full load
Mains voltage
220 (240 -10%)
200 (220 -10%)
180 (220 -20%)
115V
105V (115 -10%)
95V (115 -20%)
Nominal + 5%
Nominal output voltage
MINIMUM HOLD-UP TIME
12 and 24 UNITS
10
20
30
40
Hold up time (mS)


Half cycle 50Hz
Whole cycle 50Hz
6V Output units
full load
Mains voltage
220 (240 -10%)
200 (220 -10%)
180 (220 -20%)
115V
105V (115 -10%)
95V (115 -20%)
6.0V
5.5V
5.0V
MINIMUM HOLD-UP TIME
6V UNITS
10
20
30
40
Hold up time (mS)

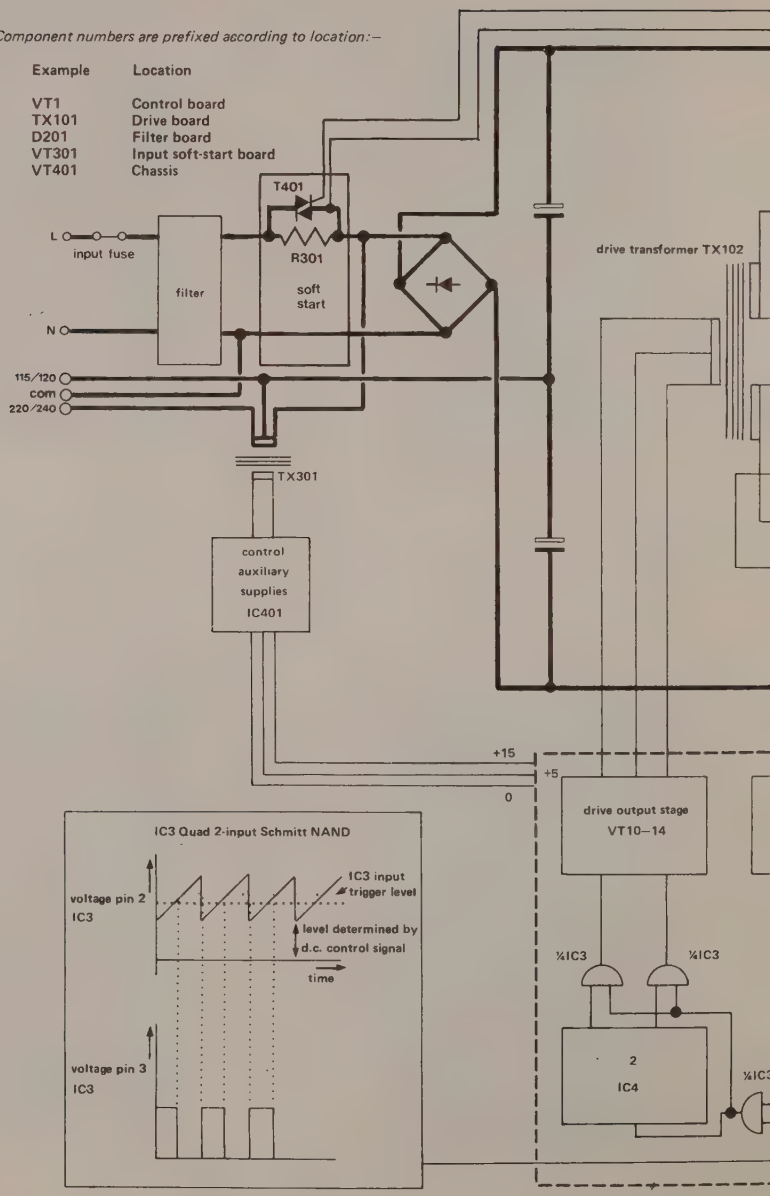

Output impedance G6-40A (typical)
mΩ
60
50
40
30
20
10
0
0.1
1.0
10.
100
kHz

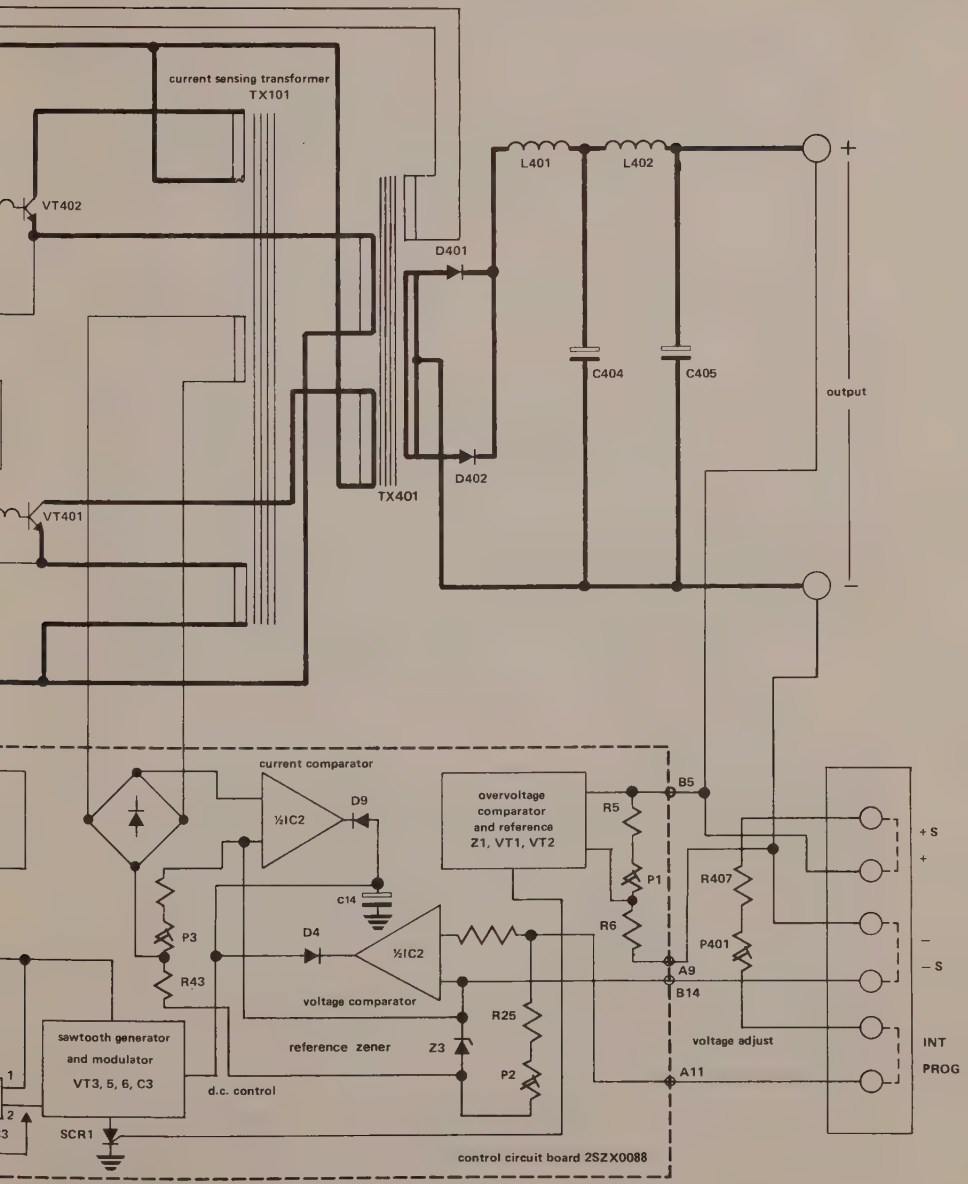

CONDUCTED R.F. VOLTAGE ON INPUT TERMINALS
Conducted and radiated interference were within VDE 0875 curve N limits on a sample G6–40A independently assessed
dB µV in 150Ω
80
70
60
50
40
30
20
10
0
Limit of VDE 0875 curve N
Neutral
Live
0.1
0.2
0.5
1.0
2
5
10.0
MHz

G. RANGE SCHEMATIC DIAGRAM

Note: Component numbers are prefixed according to location:–

Prefix	Example	Location
None	VT1	Control board
1	TX101	Drive board
2	D201	Filter board
3	VT301	Input soft-start board
4	VT401	Chassis




current sensing transformer
TX101
VT402
VT401
D401
D402
TX401
L401
L402
C404
C405
output
+
–
current comparator
½IC2
D9
C14
P3
R43
D4
½IC2
voltage comparator
overvoltage
comparator
and reference
Z1, VT1, VT2
R5
P1
R6
B5
A9
B14
R407
P401
+ S
+
– S
–
INT
PROG
voltage adjust
A11
R25
reference zener
Z3
P2
d.c. control
sawtooth generator
and modulator
VT3, 5, 6, C3
SCR1
control circuit board 2SZX0088

OPERATING INSTRUCTIONS

Warning!

Hazardous voltages exist at various points within the unit since several major areas of the circuitry are at mains potential. DO NOT REMOVE ANY COVER PLATE WITHOUT FIRST DISCONNECTING THE INPUT SUPPLY.

Mains input

The mains input terminals are located on the 3 way terminal block at the left hand side of the unit front panel and marked L (live), N (neutral) and ⏚ (earth). The unit will operate from either a 115-120V supply or a 220-240V supply by linking the correct terminals on the 3 way terminal block situated to the right of the mains input terminal block, before connecting input supply.

Warning!

Incorrect linking may result in damage to the unit

Output connections

Output is taken from the large studs on the front panel marked 'OUTPUT' '+' and '−'. Presence of output voltage is indicated by the L.E.D. located near the output terminals, (see note 2 in resistive programming section).

Remote sensing

The remote sensing terminals are situated on the 6-way terminal block on the front panel. As supplied, the sense terminals marked '+S' and '−S' are connected to the terminals marked '+' and '−' by metal links. (The '+' and '−' terminals are connected internally to the main output studs but on no account should load current be drawn from them). For remote sensing applications, both metal links are removed and the +S and −S terminals are connected to the remote load, observing correct polarity. The voltage drop in each output lead should not exceed 5V and the load voltage plus total lead drop should not exceed 6V for 6V nominal units and nominal +5% for other units.

Resistive programming

Output voltage may be programmed by removing the metal link between the 'INT' and 'PROG' terminals and connecting the external programming resistor between the 'PROG' and '+S' terminals. The programming constant is 1kΩ /V ±0.5% and the unit can be programmed from 1V to the unit maximum voltage.

Notes:-- 1) Do not remove the link between the '+S' and '+' terminals unless remote sensing operating is required in addition to resistive programming.

2) The output L.E.D. indicator varies in brightness with change in output voltage and will not be operational for output voltages below approximately 3V.

Remote on/off

The output may be reduced to zero by short-circuiting the 'PROG' and '+S' terminals.

Mounting and ventilation

The units are provided with M3 threaded fixing holes in the base and on both sides. N.B. FIXING SCREWS MUST NOT PROJECT INTERNALLY MORE THAN 6mm WHEN MEASURED FROM OUTER FACE OF POWER SUPPLY. 8mm LONG FIXING SCREWS ARE SUPPLIED.

Cooling is by natural convection and provision should be made to allow free air flow into the bottom and out of the top of the unit, particularly in the area of the main heat sink. If the unit is to be mounted on a flat plate, ventilation holes, corresponding to the unit mesh cover holes and the heatsink plan area, should be punched in the plate, or the unit raised off the plate by at least 10mm.

Units may be operated, if necessary, in an inverted position without derating.

Output hold-up

Output will be maintained for the duration of a missing mains cycle (28mS) at maximum output current and 220V -10% or 115V -10% mains input, when the output is at 6V for 6V nominal units and nominal +5% for other units. *See graph on page 5.*

Series and parallel operation

Units with the same nominal output voltage may be connected in parallel without limitation.

Units with the same output current rating may be connected in series up to a maximum total output of 250V.

CIRCUIT DESCRIPTION

The mains supply is connected through the input fuse, low pass filter and soft start circuit to bridge rectifier MR302, the d.c. output of which is fed to C401.

Linking for 115-120V connects the unit input circuit as a voltage doubler. The primary windings of the main inverter transformer TX401 are switched alternately by VT401 and VT402 across the d.c. line provided at C401.

The centre-tapped secondary output of TX401 is rectified by D401 and D402 and applied to the output terminals after filtering by L401, C404, L402 and C405.

Soft start

The charging current for C401 at switch-on is limited by resistor R301 and the unit output is inhibited by VT8 and C14. When the voltage at C14 rises output is established and R301 by-passed by triac T401..

Output voltage control

Overall control is achieved by pulse-width modulation of the inverter switch transistor base 'ON' drive signals by an amount proportional to the error between a sample of output voltage and a reference demand.

The difference between a sample of output voltage from the potential divider (R407, P401, R25 and P2) and the voltage at Z3 is amplified by the voltage comparator half of IC2 to give a d.c. control signal at the input to the sawtooth generator. This is used to determine the d.c. level of the sawtooth voltage waveform at the generator output (see in-set waveforms on the schematic diagram) which is applied to one input (Pin 2 IC3) of a Schmitt triggered NAND gate. The mark/space ratio of the resulting waveform at the gate output (Pin 3 IC3) is determined by IC3 input trigger level and the level of the applied sawtooth. Thus the d.c. control signal determines the mark/space ratio. The remaining gates of IC3 and IC4 are used to steer controlled mark/space ratio pulses via the drive output stage and drive transformer (TX102) alternately to the switch transistors (VT 401 and VT 402). When the d.c. control signal is high the mark/space ratio is greatest.

Current control

The switch transistor currents are sampled and instantaneously added by TX101. The composite waveform at TX101 secondary is rectified to provide a signal proportional to the total current drawn from the 350 volt d.c. line. This is compared with a proportion of the reference voltage at Z3. If the current proportional signal exceeds a level set by P3, the output of the current comparator section of IC2 reduces, forward biasing diode D9 and overriding the voltage control signal. The unit output voltage begins to reduce and the voltage comparator output increases, reverse biasing diode D4. Thus control is determined under these conditions by the output of the current comparator.

Overvoltage protection

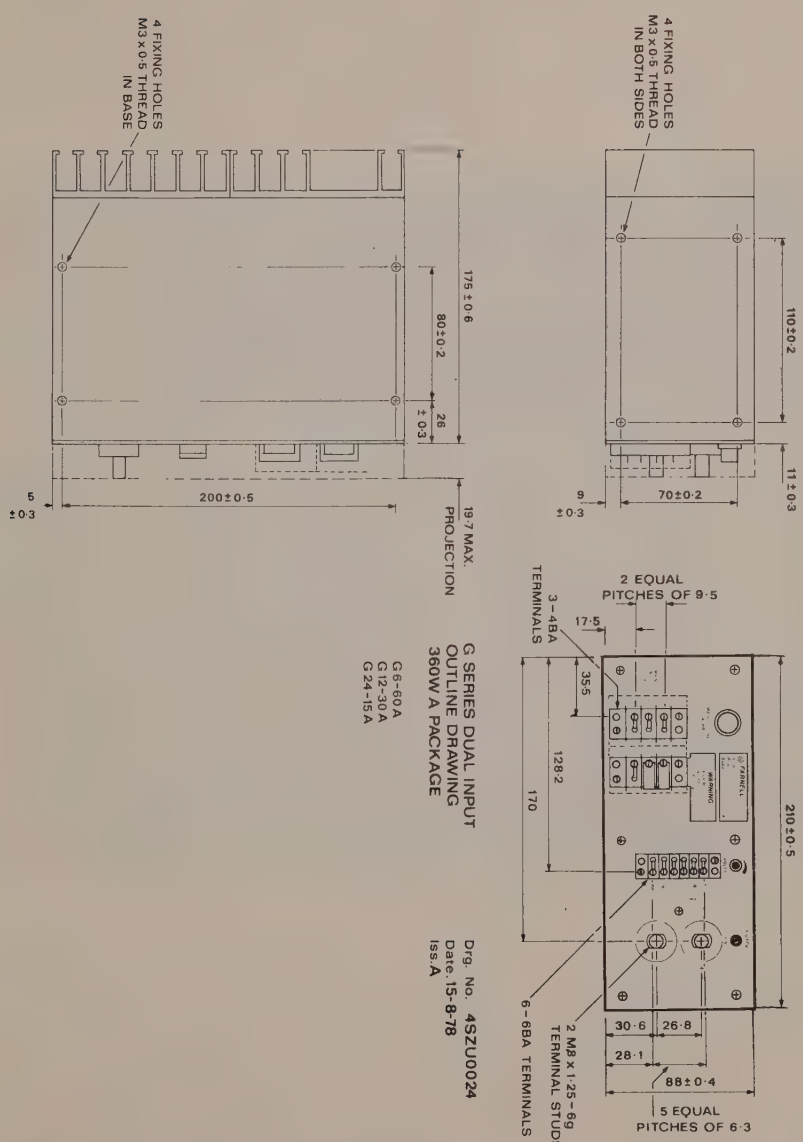
A proportion of output voltage is compared with the voltage across Z1. If the output voltage exceeds the level set by P1, the overvoltage comparator provides a positive gate signal to SCR1. The output of the modulator (and hence unit output) is inhibited as SCR1 conducts.

MECHANICAL DETAILS 240W PACKAGE

G SERIES DUAL INPUT
OUTLINE DRAWING
240W A PACKAGE

Drg. No. 4SZU0023
Date 15-8-78
Iss. A

MECHANICAL DETAILS 360W PACKAGE

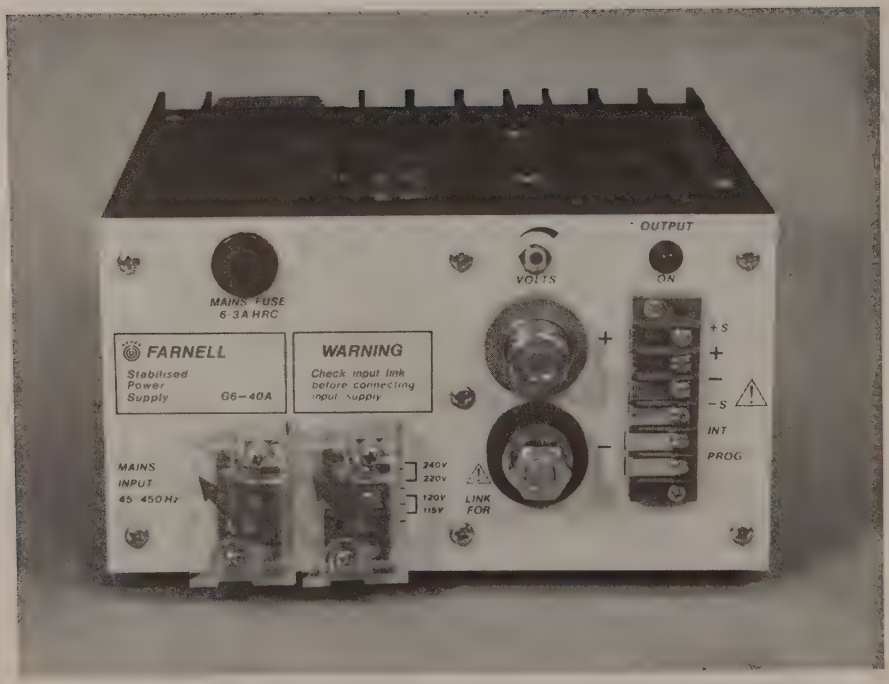


G SERIES DUAL INPUT
OUTLINE DRAWING
360W A PACKAGE

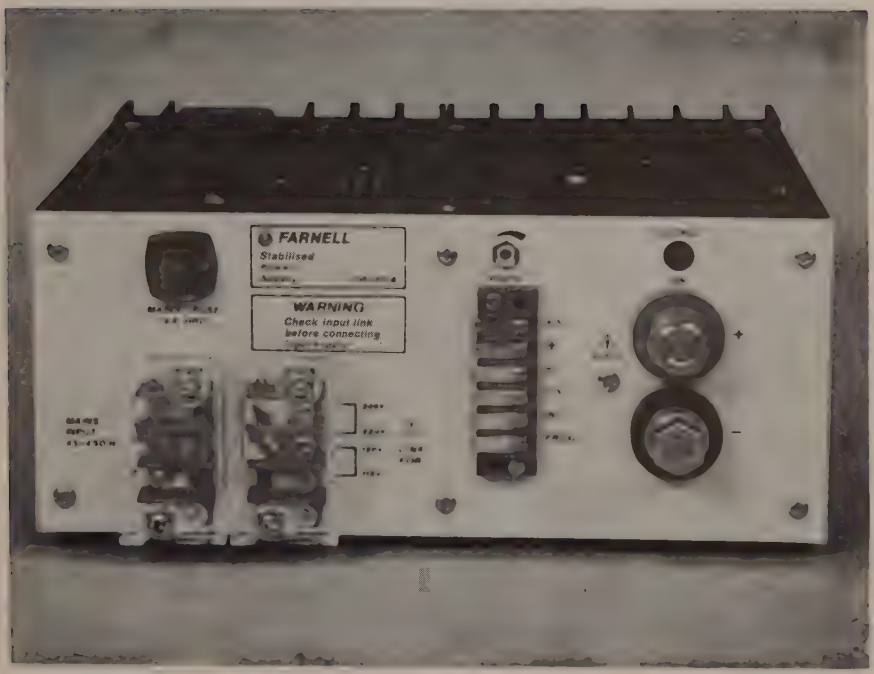
G6-60A
G12-30A
G24-15A

Drg. No. 4SZU0024
Date 15-8-78
Iss A

PHOTOGRAPH OF 240W UNIT



PHOTOGRAPH OF 360W UNIT



MAINTENANCE

The equipment supplied by Farnell Instruments Ltd., is guaranteed against defective material and faulty manufacture for a period of twelve months from the date of despatch. In the case of material or components employed in the equipment but not manufactured by us, we allow the customer the period of any guarantee extended to us.

The equipment has been carefully inspected and submitted to comprehensive tests at the factory prior to despatch. If, within the guarantee period, any defect is discovered in the equipment in respect of material or workmanship and reasonably within our control, we undertake to make good the defect at our own expense subject to our standard conditions of sale. In exceptional circumstances and at the discretion of the Service Manager, a charge for labour and carriage costs incurred may be made.

Our responsibility is in all cases limited to the cost of making good the defect in the equipment itself. The guarantee does not extend to third parties, nor does it apply to defects caused by abnormal conditions of working, accident, misuse, neglect or wear and tear.

In the event of difficulty, or apparent circuit malfunction, it is advisable to telephone (or telex) the Service Department or your local Sales Engineer or Agent (if overseas) for advice before attempting repairs.

For repairs it is recommended that the complete unit be returned to:–

The Service Department,
Farnell Instruments Ltd.,
Sandbeck Way,
Wetherby, Yorkshire,
LS22 4DH.
Tel: 0937 63541 Telex: 557294

Please ensure adequate care is taken with packing and arrange insurance cover against transit damage or loss.

Warning! — Hazardous voltages (see page 8)

If repairs are to be attempted by the customer these should be undertaken only by personnel conversant with this type of equipment.

NOTES

	G240W					G360W					GT120W
Comp	G6-40A	G12-20A	G15-16A	G24-10A	G30-8A	G6-60A	G12-30A	G15-24A	G24-15A	G30-12A	GT6-20A
Ref No	F817	F819	F856	F821	F861	F823	F825	F857	F827	F875	F828
R1	220	1k2	1k8	3k9	4k7	220	1k2	1k8	3k9	4k7	220
R5	390	680	1k	1k5	1k	390	680	1k	1k5	1k	390
R6	220	1k8	3k3	8k2	8k2	220	1k8	3k3	8k2	8k2	220
R8	LINK	LINK	LINK	LINK	LINK	LINK	LINK	LINK	LINK	—	—
R9	820	820	820	820	820	820	820	820	820	820	820
R18	680	680	680	680	2k2	4k7	4k7	4k7	4k7	4k7	4k7
R21	39k	39k	39k	39k	39k	39k	39k	39k	100k	39k	39k
R22	680	680	2k2	4k7	4k7	680	680	680	680	680	680
R24	22k	56k	56k	82k	82k	22k	22k	22k	22k	22k	22k
R31	3k9	3k9	3k9	3k9	3k9	3k9	3k9	3k9	3k9	3k9	3k9
R38	180k	330k	680k	680k	820k	120k	330k	820k	150k	—	—
R49	39	39	39	39	39	22	22	22	22	22	39
R50	120	150	150	150	150	82	82	82	100	82	68
R53	—	—	—	—	—	10K	10k	10k	10k	10k	—
R54	—	—	—	—	—	1k	1k	1k	1k	1k	—
R55	—	—	—	—	—	3k3	3k3	3k3	3k3	3k3	—
R56	—	—	—	—	—	470	470	470	470	470	
C8	4700pf	4700pf	4700pf	4700pf	4700pf	4700pf	4700pf	4700pf	4700pf	4700pf	4700pf
C10	0·01	0·01	0·01	0·01	0·01	0·022	4700pf	4700pf	2200pf	4700pf	0·01
C12	—	—	—	—	—	—	—	—	—	—	—
C13	1000pf	1000pf	1000pf	1000pf	1000pf	2200pf	2200pf	2200pf	2200pf	1500pf	2200pf
C14	22	22	22	22	22	22	22	22	22	22	22
C19	2200pf	2200pf	2200pf	2200pf	2200pf	0·01	0·01	2200pf	0·01	2200pf	2200pf
D7	IN4148	IN4148	IN4148	IN4148	IN4148	IN4148	IN4148	IN4148	IN4148	IN4148	IN4148
Z2	—	—	—	—	—	—	—	—	—	—	—
P4	—	—	—	—	—	1k	1k	1k	1k	1k	—
VT7	—	—	—	—	—	—	—	—	—	—	—
VT15	—	—	—	—	—	BC212PL	BC212PL	BC212PL	BC212PL	BC212PL	—
VT16	—	—	—	—	—	BC182PL	BC182PL	BC182PL	BC182PL	BC182PL	—
VT17	—	—	—	—	—	BC212PL	BC212PL	BC212PL	BC212PL	BC212PL	—
C11	0·022	0·01	0·01	0·01	4700pf	0·01	0·01	0·01	4700pf	2200pf	0·01

Note Capacitor value given in μF/Resistor values in Ω/Unless otherwise stated.

G SERIES DUAL INPUT CONTROL B.D. NON-STANDARD PARTS.

www.manualsplus.com

1004391

FARNELL INSTRUMENTS LIMITED - SANDBECK WAY - WETHERBY - YORKSHIRE LS22 4DH - TELEPHONE 0937 61961